



# TO WHAT EXTENT DOES STUBBLE BURNING AFFECT THE BIODIVERSITY OF INDIA, AND CREATE A THREAT TO ENVIRONMENTAL SUSTAINABILITY?

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## ABSTRACT

The timeline of the air pollution in North India is predictable. Wintertime air pollution, which is mostly caused by particulate matter from farm fires in Punjab, Haryana, and Western Uttar Pradesh, makes already severely polluted air intolerable. This supports the idea that farmers are the main architects of Delhi's air pollution crisis, and temporary fixes only work while the skies are clear. Seasonal paddy stubble burning has shown to have negative impacts; it is estimated that each year, 150,000 years of healthy life are lost as a result. However, a paddy-wheat farming system with significant consequences on the area underlies stubble burning. The prevalent practise of planting wheat in the winter season and paddy in the monsoon season results in more than just stubble burning. Additionally, it has deteriorated the land, depleted the groundwater, lowered farm earnings, increased debt, and made Northwest India more susceptible to climate change. This research paper addresses the main causes of stubble burning as well as its effects, with a particular emphasis on the problems that the people of India are experiencing as a result.

**KEYWORDS:** Pollution, stubble burning, climate change, agricultural waste, mulching, animal fodder, legislation.

## INTRODUCTION

Most often, stubble-burning is observed in northern Indian states like Punjab, Haryana, etc. After harvesting their rice, many farmers burn the remaining plant matter in order to switch between crops. The main reason for doing it is to alternate between rice and wheat crops. In the past, Stubble-burning was done to allow farmers to plant two different kinds of crops on the same piece of ground, increasing their yield and income. Compared to other removal techniques, it is easier and less expensive. Even though it is thought to be slightly dangerous, it is nevertheless regarded as acceptable in some parts of the world, albeit in very small amounts. For instance, 5% of stubble-burning is permitted in some Canadian provinces, but Punjab in India has outlawed the practice entirely due to rising pollution levels in the country's northern provinces and a number of forest fires that stubble-burning has caused (National Library of Medicine, 2019).

In the north-western Indian states, disposing of paddy residue has become a major issue, thus farmers now choose to burn the residues on-site. The management of paddy residue is crucial because it includes plant nutrients and enhances the soil-plant-atmosphere continuity. Burning biomass damages the ecosystem and removes a significant amount of vital nutrients for plants (Down To Earth, 2019).

This paper seeks to provide an overview of the practice of burning agricultural wastes in India, as well as its impacts on the environment and human health. It also discusses various alternative solutions to burning agricultural residues.

## Literature Review

Stubble burning has been reckoned among the major contributors of air pollution in India. It is a significant source of gaseous pollutants such as, carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>) and methane (CH<sub>4</sub>). The situation is more austere in India due to the intensive rice-wheat rotation system which generates large amounts of stubble. The disastrous haze observed over India during the winter season has been linked to stubble burning as it coincides with the burning periods (October-November). The crop stubbles (if managed properly) could provide immense economic benefits to the farmers and protect the environment.

The use of stubble as fuel in power plants, raw material for the pulp and paper industry, or the creation of biofuel are a few examples of alternative management techniques. The majority of farmers in North India believe burning to be the best option since they are unaware of the several alternatives to manage stubble. In addition to having an impact on air quality, stubble burning also has an impact on economic growth, climate, and soil fertility (by destroying the nutrients in the soil).

## Body

Burning stubble is one of the main causes of atmospheric pollution, emitting gaseous and particulate pollutants that have detrimental impacts on both human health and the environment. Even though it ranks third after industrial and vehicle emissions, it is still a substantial source of air pollution in many regions of the world. Stubble burning is the deliberate combustion of crop residue by farmers after harvest. Stubbles are the cut stalks that have been left on a field after cereal plant grains or sugarcane stems have been picked. However, in Asian nations like China, almost 60% of the total biomass emissions come from the burning of stubble, not from other biomass burning activities like burning wood for cooking

food, igniting municipal rubbish in open fields, or starting wildfires. Including forest fires, stubble burning accounts for around one-fourth of all biomass burning worldwide (IshaAbdurrahman et al., 2020).

Despite its many drawbacks, stubble burning is still practiced in India, particularly in the states of Punjab, Haryana, and others. The main reason for this is that farmers there are so accustomed to this practice that it is all they are aware of. They also continue to alternate between growing rice and wheat because they want to increase their incomes (National Library of Medicine, 2019).

Adapting to change is challenging for them, and on top of that, they struggle to learn and practice current eco-friendly residue management techniques because all of the farmers are so accustomed to their traditional practices that they struggle to adopt new ones (National Library of Medicine, 2019).

The world's food output has greatly increased as a result of the rising food demand in developing nations. Therefore, agro-based firms are lucrative ventures in both developed and developing nations. Agro-product production is increased by the diversity of agricultural practices, which has resulted in an overall rise in waste production and environmental damage. The type of operations carried out and the trash produced depend on the geographical and cultural characteristics of a nation. Due to advancements in water management systems, contemporary agrotechnology, and large-scale pesticide deployment, extensive areas of wasteland have been transformed into agricultural lands. These actions have raised the difficulty of disposing of agricultural waste and polluted the environment worldwide (Bhuvaneshwari et al., 2019).

The main issues that the locals deal with include chest congestion, lung disorders, eye irritation, and eye dryness. During October 2016 and November 2017, the National Capital Region [NCR] of Delhi, Haryana, and Punjab had devastating pollution effects. Air pollution (smog), particularly indoor air pollution, which is also a risk factor for developing pulmonary TB, chronic obstructive pulmonary disease, pneumoconiosis, bronchitis, cataract, corneal opacity, blindness, and other health issues were caused by these instances. 20,000 premature fatalities occur each year in Delhi NCR alone as a result of severe air pollution (Singh, 2017).

According to a 2016 study by Vitull K. Gupta, professor of medicine at Bathinda, 84.5% of people experience health issues as a result of a rise in smog. It was shown that 768.8% of respondents reported irritation in their eyes, 44.8% in their nose, and 45.5% in their throat. 41.6 percent of respondents reported coughing or an increase in coughing, and 18 percent reported wheezing. According to a different study by the Institute for Social and Economic Change in Bengaluru, Punjabi rural residents spend Rs 7.6 crore annually on medical care for illnesses brought on by burning stubble (Gupta, 2022).

## Legislations

The Delhi High Court ordered Uttar Pradesh, Delhi, Punjab, Haryana, and Rajasthan to implement a comprehensive policy to address the issue of outdoor stubble burning in their respective regions on October 8, 2016. Following this instruction, the aforementioned states swiftly passed harsh legislation, including penalties, prohibiting the burning of any stubble within their borders. For instance, 1406 producers in Haryana were penalized a total of 1.375 million rupees on November 26, 2016, after being found to be in violation of the regula-

tion. Numerous farmers in Punjab received direct seeders from the Punjab government in 2017, which made it easier to incorporate paddy straws into the soil. The government has suggested decreasing the area used for paddy growing by nearly 700,000 acres by 2020, or roughly 10% of the total land area used for paddy cultivation in 2019 (IsaAbdurrahman et al., 2020).

The National Clean Air Programme (NCAP), which would be executed over the next five years, was launched by the Indian government in 2019. The program's main goal was to utilize 2017 as the baseline year and reduce particulate matter emissions to 20–30% by 2024. The initiative requires all agencies, regardless of level, and all partners to take a collaborative and participative approach. Additionally, it was intended to plant trees by 2060 that would absorb 2.3 billion tonnes of CO<sub>2</sub> equivalent in order to address the transboundary transfer of emissions. According to the analysis, if this objective were to be achieved, IGP citizens' average lifespan would rise by up to 2 years (IsaAbdurrahman et al., 2020).

### Alternatives to Stubble Burning

It is important to create innovative residue management technologies that are both environmentally friendly and cost-effective in order to adopt appropriate choices of alternative crop residue management strategies. Decisions on crop residue management should be evaluated in terms of productivity, gain, and environmental impact. These standards would overlap with those used in the ecological intensification strategy for intensive agricultural systems attempting to satisfy the rising need for food, feed, fiber, and fuel while achieving acceptable levels of environmental quality.

### Organic Fertilizer

The management of crop residue and the reduction of stubble burning are global concerns. Approximately 1.4 tonnes of straw are left on the crops after each tonne of harvested rice, and a similar ratio holds true for the other important crops as well. In India, the most popular technique for managing these massive amounts of crop waste is still direct on-farm burning. The creation of biogas from crop wastes may be a practical and environmentally responsible solution. In addition to providing controlled waste management and lowering harmful pollutants and greenhouse gas emissions, biogas is a renewable energy source. When applied as an organic fertilizer, decomposed sludge ultimately accomplishes a long-term cycle of recycling nutrients back into the soil. Crop leftovers have considerable biogas potential due to their high organic content. The majority of energy crops have demonstrated methane outputs of about 300 m<sup>3</sup>/t of organic matter. This gas might be improved to bio-methane, utilized as fuel, or turned into energy. Different pre-treatment techniques and co-digestion of the substrates have been suggested as ways to further enhance the procedure (Satpathy and Pradhan, 2020).

### Mulching

Mulching refers to the protective soil covering done with sawdust, compost, or paper to control pests, minimize erosion, reduce evaporation, enrich the soil, or clean fruit. In order to mulch, biomass must typically be moved from the field before the soil is prepared and then returned when the soil is ready. Some farmers in India choose to leave their early rice crop's land wet during the brief conversion to the late rice crop transplantation after the rice has been harvested. While other Indian rice farmers have attempted to avoid flooded rice systems that allow agricultural residue to be retained on the surface, placing lengths of straw from early grain as mulch along the transplanting path for late grain helps ensure that soil is damp enough just to allow late grain transplants, helps to control the growth of weed, and discourages rice from decomposing. In many northern cities, including Uttar Pradesh, producers either scatter rice seeds or physically sow rice that has had germination. Agricultural wastes are kept on the soil surface in these systems. Herbicides are used to control weeds while soil is inundated or saturated during plants growth. Before combining harvests, some farmers plant rice in wheat fields using relay crops. The standing wheat stubble steadily deteriorates during the rice crop. A rice system for rice production (GCRPS) blankets the soil under non-flooded conditions with soil covered with rice straw paws throughout growth in order to save resources and boost efficiency, although the grain output was frequently lower than in flooded rice. Retaining the residue onto the field during harvest, when it doesn't need to be taken and added until plowing, makes it relatively simple to keep the residues on the soil like a mulch (Porichha et al., 2021).

### Animal Fodder

The practice of using rice leftovers as animal fodder is not very common among Punjabi farmers. This is mostly caused by the rice residue's high silica content. Nearly 40% of the wheat straw grown in the region is thought to be utilized as dry livestock feed. However, an experimental project was initiated by PSCST at PAU under which tests on natural fermentation of wheat straw for use as nutrient livestock feed were done in order to promote the use of rice waste as animal fodder. The health and milk output of the cattle fed with this diet improved. In Bathinda, Gurdaspur, Ludhiana, and Hoshiarpur, the technology was shown. The technology has been spread throughout the province by the Punjab Department of Animal Husbandry. Uttar Pradesh has the most agricultural residue available, followed by Maharashtra, Bihar, Rajasthan, and Andhra Pradesh. The least amount of agricultural residue is available in nearly all of the north eastern States, with the exception of Assam and Kerala. Similar to availability, Uttar Pradesh has the largest demand for crop residue, resulting in a high requirement per animal (0.99 t/animal) and a high availability per animal (0.07 t/animal) for the state. When

opposed to other Indian states, states like Punjab, Haryana, and Bihar have a larger per-animal availability (Kumar et al., 2022).

As alternatives to burning stubble, there are numerous different methods and solutions that can be utilized.

### Conclusion

The large-scale rice-wheat crop rotation technique used in India has produced massive amounts of crop stubble, frequently more than the number of harvested grains. When these stubbles are typically burned on-field to prepare the farm for the following planting, hazardous chemicals are released into the environment, which further deteriorates the air quality. Based on existing literature, it can be concluded that the severity of the air quality, particularly during occurrences of rice stubble burning in north Indian towns, is caused by the interactions between emissions from stubble burning and climatic conditions.

The health of the population exposed to the pollutants from burning stubble is seriously at danger because they have been related to a number of health problems, including in some extreme cases, death. Burning stubble may cause climate change, global warming, and the loss of soil nutrients in addition to atmospheric pollutants. Therefore, comprehensive policies must be put in place immediately to stop this threat at its source.

As opposed to burning, the stubbles can be used to create environmentally benign and economically advantageous products like compost or biochar. In addition, they can serve as biomass for the production of biofuels, fuel for power plants, blends for the creation of cement and bricks, and raw materials for the manufacture of pulp and paper. The majority of farmers in North India do not know about these abundant alternatives and view burning as their best option as a result. This calls for extensive awareness campaigns to inform producers about the range of financially viable alternatives and the overall effects of stubble burning.

The practice of burning continues across most of northern India, particularly in Punjab, Haryana, and Uttar Pradesh, despite the stringent policies and laws that the Indian government at the both federal and state levels has set in place to outlaw it. Effective follow-up with prompt and ongoing surveillance at all locations is required for patriotic compliance with these standards.

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